International Journal of Engineering Research (ISSN : 2319-6890)
Volume No.2, Issue No. 7, pp : 449-451 01 Nov. 2013

Applicability of Forecasting Models and Techniques for Stationery Business: A Case Study from Sri Lanka

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Abstract

A demand forecasting methodology for a stationery company in Sri Lanka is being investigated. Different forecasting methods available are looked at including judgemental methods, quantitative methods and Artificial Intelligence methods. Importance of using a combination of methods available instead of using a single method is emphasised by the literature.

Key Words: Demand Forecasting, Stationery, Time Series, Genetic Algorithms

I Introduction

I.I Demand Forecasting

With the advancement of technology and innovation the world today is moving ahead in a rapid speed making the business environment more dynamic. Hence risk and uncertainty have become major topics in concern when engaging in business. The requirement of the customer being much more unpredictable, the wisdom of foreseeing the future has become a valuable and essential aspect within the business context.

Demand forecasting can be explained as making estimations about the future sales of a certain product or service to customers. It could be either carried out as a bottom-up level approach where judgmental approaches are used or could be conducted using advanced methods that have been developed by statisticians. General approach to forecasting includes judgmental approaches, experimental approaches, relational/casual approaches and time series approaches.

I.II Importance of demand forecasting for stationery business

Better inventory management.

Make-to-stock concept is discouraged by modern manufacturing technologies such as Total Quality Management (TQM) and Just In Time (JIT). Demand for stationary in Sri Lanka inherits a seasonal effect. Hence accurate demand forecasting will help to avoid large stocks piled up in the inventory. This will also reduce the risk of damage/ loss of inventory, obsolescence etc.

Better planning and control

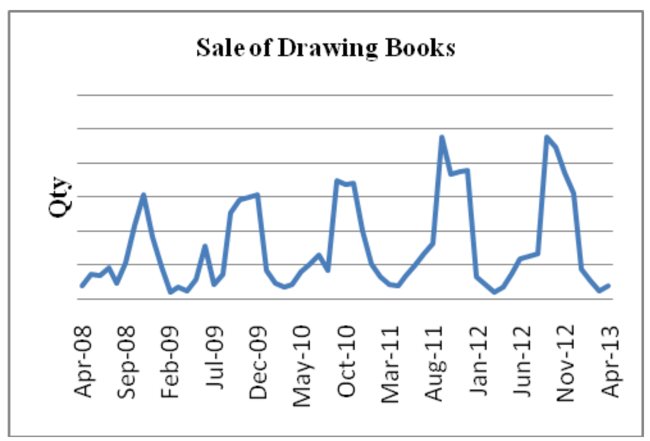
Demand forecasting could be identified as a trigger point for many activities carried out in a business. A good demand forecast helps in better planning the supply of raw materials and other inputs, price, promotional activities etc. It will control the amount of internal costs such as storage cost and wastage as well as external costs such as loss of customer perception, opportunity cost, loss of market share.

Feed forward approach

Demand forecasting pictures possible outcomes in future. Hence decision makers will have the privilege of responding in advance for unfavourable situations and they are allowed to be better prepared for opportunities.

I.III Stationery Industry in Sri Lanka

The stationery industry in Sri Lanka includes number of players including both state and privately owned ventures. (1).The trade is affected by many factors such as quality, price and distribution. The demand of stationery strongly depicts seasonal and cyclical variations. An analysis of the data gathered from the chosen business entity provides sufficient evidence for it.



II Forecasting Methods and Models

Demand forecasting methods can be identified as judgmental methods and statistical methods. Latter requires quantitative data. (2)

Methods based on judgment	Methods requiring quantitative data
Unaided judgment Prediction markets Delphi	Extrapolation Quantitative analogies Rule-based forecasting

Intentions and expectations surveys	Neural nets
Judgmental decomposition	Data mining
Judgmental Bootstrapping	Casual models
Simulated interaction	Segmentations

Although there are qualitative methods applicable, it is recommended to avoid their usage where ever quantitative data is available. (2)

II.I Time Series Approach to forecasting

Time Series Patterns

Stationary demand

If demand is persistent over time apart from minor fluctuations that might be caused by random effects, it is said to have a stationary pattern. If the noise is large the results are prone to errors.

$$Z_t = L + e_t$$

L- level of series

e_t – noise related to period t

Trend

The series of demand may have a move in one direction either upwards or downwards. If it is upwards it is identified as the demand is growing and vis-a-vis. A time series consists of both trend and noise components.

Seasonality

This is the tendency of the series to have regular high and low movements over time

Summary of time series forecasting methods (3)

Method	**Mathematical Model**	**Innovative Features**	**Limits**
Single exponential smoothing	-Exponential smoothing	-Adapt for low periods of forecast -Easy to compute	-Deterministic model -Few fields of applicability
Croston's method	-Exponential smoothing	-Adapt to demand with a lot of zero values	-Deterministic model
Moving average	-Arithmetic Mean	-Adapt for constant demand -Easy to compute	-Deterministic model -Few fields of applicability
Additive Winter	-Exponential smoothing -Sum of components	-It considers the effect of seasonality	-Deterministic model -If only few fields have seasonality it's a limit
Poisson method	-Probabilistic model	-Values the demand in a probabilistic way -Adapt in case of rare demand	-Doesn't give a punctual value
ARIMA(Box-Jenkins Methods)	-Autoregression -Weighted average of residuals	-Possibility to consider non-stationarity and seasonality	-Require lot of historical data to give good results

Martingale Model of Forecast Evolution (MMFE)

This is a general probabilistic model that can be used to evaluate the demand in order to find an economical safety stock factor. MMFE can be used along with the linear programming model in simulation. (4)

II.II Artificial Intelligence in Forecasting

Neural Networks, fuzzy logic, Genetic Algorithms are some Artificial Intelligence methods that can be used for forecasting. These methods are capable of providing near optimal solutions.

Neural Networks fail to provide accuracy when validated with test data because it tends to capture only the local minima/maxima instead of global minima/maxima in the training data set. (5)

Baseline and Activities Forecast Integration Model (BAFI)

Combined statistical methods tend to yield better results than individual methods in means of accuracy and risk. Baseline and Activities Forecast Integration (BAFI) model, which is a hybrid model, incorporates both controllable (ex: historic sales), and uncontrollable (ex: weather) factors as inputs and models demand factors with demand series. Genetic Algorithms could be used in optimizing the results gained from different solution options. (6)

III. Relevance to Sri Lanka Stationers

Prime products in the stationery industry in Sri Lanka depicts strong seasonality incorporated with its demand. But there are also number of items with difficult to predict demand patterns.

The current practise of stationers is to highly depend on the judgemental approach by using the expert knowledge available internally.

Judgemental methods are convenient and easy to be carried out. It does not require expert knowledge on forecasting or any sophisticated systems and will not incur substantial costs in carrying out. But these advantages are only after compromising the accuracy and dependability of the results. It also lacks long term focus.

Reducing the dependence on judgemental methods and adopting statistical methods will be helpful in mitigating the drawbacks and risks of judgemental methods. Hence avoiding intuition and relying on quantitative methods can be recommended for the stationery business.

Furthermore the general practise of generating a forecast for a whole year and updating it in three months intervals is discouraged. If the forecasting horizon is brought down it will improve the accuracy of the forecasts.

Along with the usage of methods such as MAD and MAPE, the cost of a poor forecast could also be adopted as accuracy measures. (7) This cost could be estimated by looking at the opportunity costs of lost sales, increased inventory, damages made at the warehouses etc. Such a method will be helpful in providing a more realistic view on the negativities of the variance.

Usage of combination of forecasting methods instead of depending on one method will be successful. Artificial Intelligence methods could be adopted to improve the derived forecasts. Hence retrieving demand forecasts from appropriate statistical methods and finally choosing the optimum forecast using Genetic Algorithms can be identified as a suitable method in forecasting stationery demand. But it should be noted that Genetic Algorithms is only capable of providing near optimal results. In order to achieve 100% accuracy in the results, exact methods have to be used.

IV. Conclusion

Forecasting models are available based on exact methods and heuristics. But heuristics will provide only near optimal results. No any single method has proven to be more accurate in forecasting than using a combination of methods. Genetic Algorithms can be employed to improve a forecast derived from quantitative methods.

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